

**Appendix H**

**Long-Term Monitoring and Maintenance Plan**

## **Appendix H - Long-Term Monitoring and Maintenance Plan**

### **Summary**

This Long-Term Monitoring and Maintenance Plan details steps to be taken to ensure continued integrity and effectiveness of the Pond 2 final cover system at Hecla Mining Company's Apex Site. The key elements of the plan are:

- ▶ detection methods (monitoring schedule and site inspection methods)
- ▶ allowable limits (guidelines for interpreting monitoring results)
- ▶ remediation plan when/if limits are exceeded (list of preventative maintenance activities)

The plan contains the following items:

- ▶ monitoring schedule and site inspection methods
- ▶ guidelines for interpreting monitoring results
- ▶ list of preventative maintenance activities

Also included in this plan are a site inspection checklist and forms for the annual site inspections.

### **Monitoring Schedule and Site Inspection Methods**

Site inspections will provide early warning of potential problems which could impact the final cover system's integrity. The Apex Site should be inspected annually to verify that the final cover system is functioning properly and to ensure that no significant problems are developing. The monitoring period may require adjustment based on data collected from the first inspection, as monitoring periods are a function of the stability of the waste and cover system.

Areas to be inspected annually include:

- ▶ Site Perimeter - site boundary and outlying areas up to 1/4 mile beyond Hecla's fence line. This includes the property fence, site entrance gate, and all upgradient drainage areas.
- ▶ Impoundment - top and outslopes, Protection Layer (top surface materials), and Surface Layer (erosion protection)
- ▶ Diversion Channel - erosion protection, normal flow channel, intersections with site perimeter fencing

The primary purpose of the annual inspection will be to look for evidence of significant movement of materials such as:

- ▶ cover subsidence
- ▶ excessive slope movement or failure
- ▶ gully development
- ▶ excessive siltation
- ▶ leachate migration

**Guidelines for Interpreting Monitoring / Inspection Results**

Table 1 on the following page contains details of how monitoring / inspection results should be interpreted, sets allowable limits, and provides an outline for repair activities required if allowable limits are exceeded.

Table 1

Problem Identification, Allowable Limits, and Repairs<sup>1</sup>

Cover System Component	Problem	Allowable Limits	Repair if Allowable Limits are Exceeded
Cover System	Cover System Subsidence	ponding > 1" or gulying / erosion	<ul style="list-style-type: none"> <li>▶ backfill with additional cover material (TP-1, silty sand with gravel) to achieve lines and grades of original final cover surface</li> <li>▶ minimize any flow concentration locations (potential pooling or erosion areas)</li> </ul>
		see Table 2	<ul style="list-style-type: none"> <li>▶ remove Protection Layer and GCL in area of subsidence</li> <li>▶ place light weight fill to achieve lines and grades of original subgrade</li> <li>▶ replace / repair GCL</li> <li>▶ replace Protection Layer</li> </ul>
	Embankment Slope Instability	no signs of excessive embankment movement or surface cracks greater than 1"	<ul style="list-style-type: none"> <li>▶ remove erosion protection</li> <li>▶ reconstruct embankment with additional embankment material (TP-1, silty sand with gravel) to achieve lines and grades of original embank surface (or flatter) and minimize any flow concentration locations (potential pooling or erosion areas)</li> <li>▶ add toe berm along base of slope in failure area</li> <li>▶ replace erosion protection</li> </ul>
	gully development on impoundment top	depth > 1"	backfill to original grade with similar material type (TP-1, silty sand with gravel)
	gully development at embankment crest or on outslope	depth > 2"	backfill to original grade with similar material type ( $D_{50} = 1"$ rock)
	gully development from normal flow channel in diversion channel parallel to and at toe of impoundment outslope	no gulying allowed	<ul style="list-style-type: none"> <li>▶ replace/repair any disturbed erosion protection (either <math>D_{50} = 1"</math> or <math>D_{50} = 3"</math> rock)</li> <li>▶ backfill gully to original grade with native materials</li> <li>▶ grade normal flow channel within diversion channel away from impoundment embankment</li> </ul>
	gully development in diversion channel at any other location in diversion channel	NA	no repair required
	seepage through embankment	no seepage allowed	<ul style="list-style-type: none"> <li>▶ remove embankment material in seepage area</li> <li>▶ repair GCL liner and/or tie-in with original impoundment liner</li> <li>▶ replace embankment material</li> <li>▶ replace erosion protection</li> </ul>
Runoff Control System	excessive silt build up at fence lines in diversion channel	allowed if not effecting cover system	<ul style="list-style-type: none"> <li>▶ clear silt, organics, debris</li> <li>▶ modify diversion channel alignment and/or gradients</li> </ul>

<sup>1</sup> EPA 1988 - Guide to Technical Resources for the Design of Land Disposal Facilities

Cover System subsidence monitoring will be conducted by a visual inspection of the surface and a survey of the <sup>10</sup>six installed settlement monuments. If the visual inspection, or settlement monument survey results, show that different areas of the cover are subsiding at substantially different rates (ponding greater than 1" and/or erosion and gullyng), then a further and more detailed survey shall be conducted to delineate the area(s) of differential subsidence, and the amount(s) of maximum subsidence in each area. As noted in Table 1, there are separate repair methods for the two allowable subsidence limits listed. The first repair method is for "minor" differential subsidence, or that which will not potentially lower the permeability of the GCL. This method basically consists of adding Protection Layer material to achieve the original cover surface elevations and grades. The second repair method is for "significant" differential subsidence, or that which may lower the permeability of the GCL. If the calculated maximum differential settlement for a subsidence area is less than that shown in Table 2 below, then the first level of repair is adequate. If the calculated maximum differential settlement for a subsidence area is greater than that shown in Table 2, then the second level of repair will be required. Cumulative subsidence, and corresponding levels of repair, must be taken into account over time.

Table 2 Guidelines for Allowable Differential Settlement	
Radius of subsidence area (ft)	Maximum Differential Settlement (in each subsidence area)
1	0.2
2	0.4
5	1.0
10	2.0
25	5.0

Guidelines for maximum subsidence that GCL can withstand without damage (i.e., any lowering increase in permeability). (Daniel 1995)

### Preventative Maintenance Activities

Preventative maintenance may be required for two to three years after completion of cover construction. As listed in Table 2 on the following page, maintenance activities in specific areas may include, but are not limited to the following activities:

- ▶ **minor differential subsidence** - place additional Protection Layer material to minimize flow concentration locations
- ▶ **large / potentially damaging differential subsidence** - remove Protection Layer and GCL, place light weight fill to achieve lines and grades of original subgrade, replace / repair GCL, replace Protection Layer
- ▶ **excessive movement or failure of impoundment embankments** - remove erosion protection, reconstruct embankment with additional material to achieve lines and grades of original

embankment surface and minimize any flow concentration locations, add toe berm along base of slope, replace erosion protection

- ▶ **excessive surface erosion (gullying)** - place additional Protection Layer to achieve original lines and grades, place additional erosion protection or other materials as required
- ▶ **gullying at toe of the impoundment within the diversion channel** - backfill gully to original grade with native materials, replace/repair disturbed erosion protection, grade normal flow channel within diversion channel away from impoundment embankment toe
- ▶ **excessive siltation** - clean / clear soil, organics, or other deleterious materials from diversion channel or fences, modify diversion channel alignment and/or gradients
- ▶ **leachate migration** - remove embankment material in seepage area, repair GCL liner and/or tie-in with original impoundment liner, replace embankment material, replace erosion protection

### References

EPA 1988. *Guide to Technical Resources for the Design of Land Disposal Facilities*, Risk Reduction Engineering Laboratory, Cincinnati, OH, EPA/625/6-88/018.

EPA 1991. *Design and Construction of RCRA/CERCLA Final Covers*, Seminar Publication, Office of Research and Development, Cincinnati, OH, EPA/625/4-91/025

EPA 1998. *Evaluation of Subsurface Engineered Barriers at Waste Sites*, Office of Solid Waste and Emergency Response, EPA/542/R-98/005.